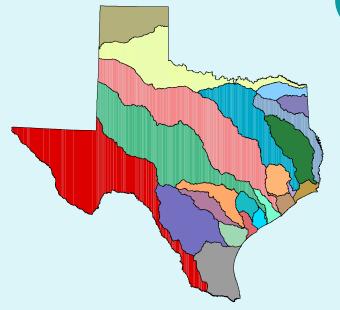
## Colorado-Lavaca Basin and Bay Area Stakeholder Committee

# DISCUSSION OF WATER AVAILABILITY MODELS (WAMs)



**Bob Brandes**October 28, 2010

#### Today's Discussion

- WAM Development and Structure
- WAM Data Input Requirements
- WAM Simulated Outputs
- Important Features and Assumptions
   With Regard to Colorado Basin WAM
- Stakeholders Use of WAMs

#### What is a Water Availability Model, WAM?

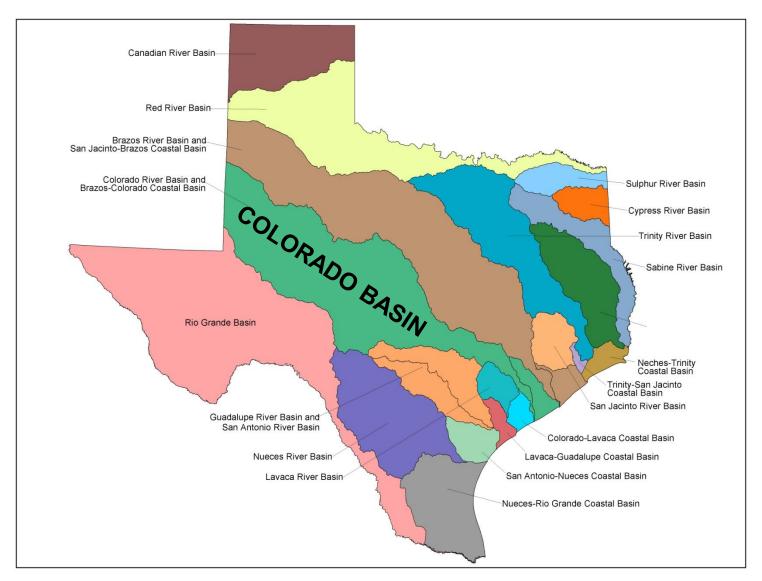
A <u>Computer Program with Supporting Data Files</u> that Simulates a <u>Monthly Time Series of Available Surface</u> Water for Individual Water Rights in a Basin Over a Long-Term Period of Record, Considering:

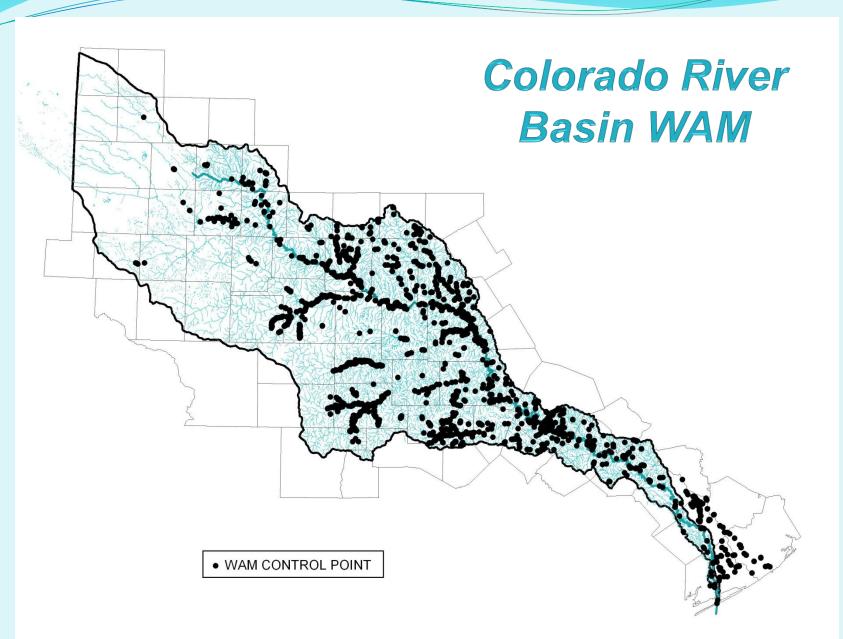
- Historical Hydrologic Conditions and Variations
- Locations of Individual Water Rights
- Specified Diversion Amounts and Rates and Reservoir Storage Capacities
- Specified Types of Water Use
- Priorities Among Individual Water Rights
- Special Conditions of Water Rights

#### Development of Current WAMs

- Senate Bill 1 in 1997 Authorized Development of Water Availability Models (WAM's) for 22 of 23 River and Coastal Basins in Texas
  - 6 Basins Completed by End of 1999
  - 16 Basins Completed by End of 2001
- House Bill 76 in 1999 Authorized Development of Rio Grande WAM
  - Texas and Mexico Basins
  - Completed by March 31, 2004

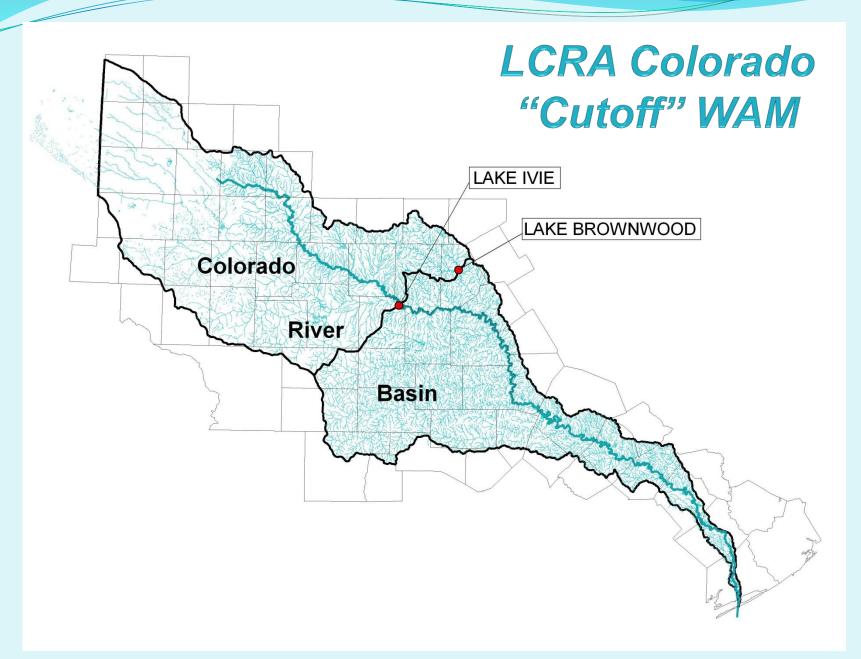
#### 20 Current Water Availability Models



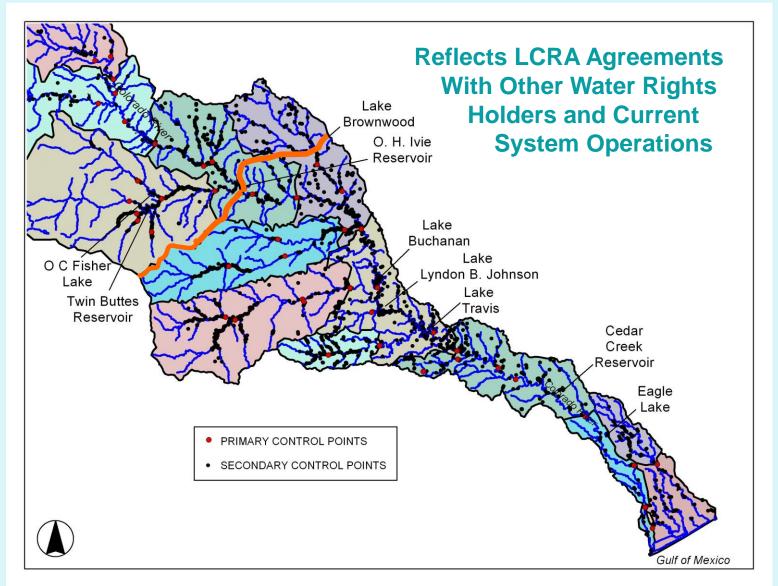


#### Different Versions of WAMs

- TCEQ Permitting WAMs
  - Run 3 Full Water Rights Authorizations and No Return Flows
  - Run 8 Current Conditions Demands, Reservoir Capacities, and Return Flows
- Regional Water Planning WAMs (Run 9)
  - Projected Future Demands, Reservoir Capacities, and Return Flows
  - Proposed Water Supply Strategies
- Special Purpose WAMs



#### LCRA Colorado "Cutoff" WAM



#### WAM Data Input Requirements

#### WAM Data Input Requirements

- Basin Hydrologic Configuration
  - Control Point Definitions / Assignments
  - Stream Segments Connectivity
- Naturalized Flow Records Primary Control Points
- Water Right Specifications
  - Locations (Diversion Points / Reservoirs)
  - o **Priority Dates**
  - Authorized Diversion Amounts / Rates
  - o Type of Use (Municipal, Irrigation, etc.)
  - Authorized Storage Amounts
    - On-Channel Reservoirs
    - Off-Channel Reservoirs

#### WAM Data Input Requirements (cont'd.)

- Water Rights Special Conditions
  - Environmental Flow Restrictions
  - Subordination Agreements
- Diversion Procedures
  - Supply Priorities
  - o Curtailment Requirements
- Return Flow Specifications
  - Discharge Locations
  - Monthly Amounts Relative to Diversions
  - Specified Monthly Amounts (Groundwater-Based)

#### WAM Data Input Requirements (cont'd.)

- Reservoir Operating Rules
  - Storage Zone Priorities
  - System Operating Procedures
  - Diversion Rules for Off-Channel Reservoirs
- Historical Reservoir Evaporation Rates
- Reservoir Depth-Area-Capacity Relationships
- Channel Loss Specifications
- Interbasin Transfer Specifications
  - o Diversion Locations
  - Junior Priority Implementation

#### **WAM Simulated Outputs**

#### Simulated Outputs From WAMs

- Simulated Monthly Diversions for All Water Rights
- Diversion Reliabilities for All Water Rights
  - Volume Average Percentage of Authorized Amount That Is Available for Diversion
  - Period Percentage of Time Authorized Amount Can Be Diverted (Monthly or Annual)
- Simulated End-of-Month Reservoir Storage
- Simulated Monthly Return Flows
- Simulated Monthly Regulated Streamflows
- Simulated Monthly Unappropriated Streamflows

#### Simulated River Diversions

Priority Date: 07-25-1983

Authorized Diversion Amount: 75,000 ac-ft/yr

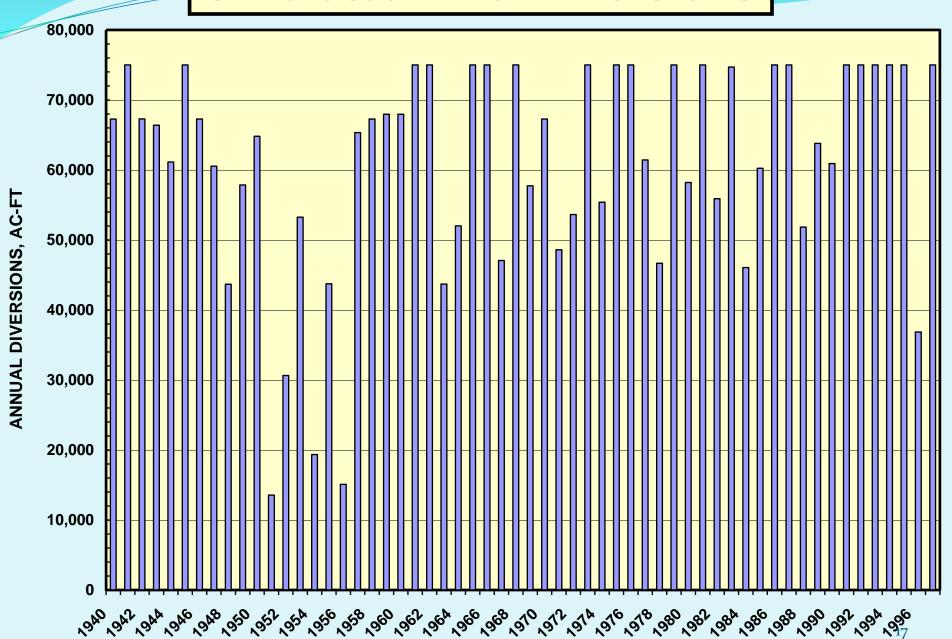
Annual Period Reliability: 34.5%

Monthly Period Reliability: 81.0%

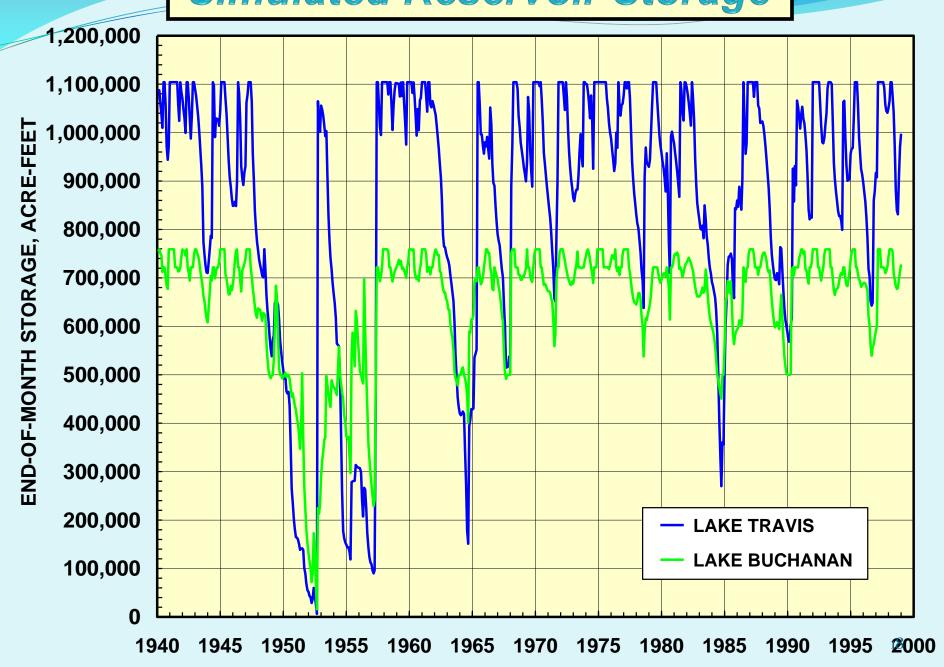
Annual Volume Reliability: 81.4%

	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	1940	2,528	4,945	0	6,144	6,818	7,418	8,092	7,717	7,043	6,369	5,470	4,720	67,264
	1941	4,720	4,945	5,545	6,144	6,818	7,418	8,092	7,717	7,043	6,369	5,470	4,720	75,000
	1942	4,720	4,945	5,545	6,144	6,818	7,418	8,092	1	7,043	6,369	5,470	4,720	67,284
	1943	4,720	4,945	5,545	6,144	6,818	7,418	8,092	6,150	0	6,369	5,470	4,720	66,390
	1944	4,720	4,945	5,545	6,144	6,818	7,418	8,092	0	7,043	225	5,470	4,720	61,139
	1945	4,720	4,945	5,545	6,144	6,818	7,418	8,092	7,717	7,043	6,369	5,470	4,720	75,000
	1946	4,720	4,945	5,545	6,144	6,818	7,418	8,092	0	7,043	6,369	5,470	4,720	67,283
	1947	4,720	4,945	5,545	6,144	6,818	7,418	0	7,717	7,043	0	5,470	4,720	60,540
	1948	4,720	4,945	5,545	6,144	6,818	7,418	8,092	0	0	0	0	0	43,682
	1949	2,340	4,945	5,545	6,144	6,818	7,418	8,092	0	0	6,369	5,470	4,720	57,859
	1950	4,720	4,945	5,545	6,144	6,818	7,418	8,092	7,717	7,043	6,369	0	0	64,810
	1951	0	0	0	6,144	0	7,418	0	0	0	0	0	0	13,562
	1952	0	0	5,545	6,144	6,818	7,418	0	1	0	0	0	4,720	30,646
	1953	4,720	4,945	5,545	0	6,818	7,418	214	1	7,043	6,369	5,470	4,720	53,262
	1954	4,720	389	0	0	6,818	7,418	0	0	0	0	0	0	19,345
	1955	0	4,945	0	6,144	6,818	7,418	1,377	9	7,043	6,369	3,616	0	43,739
	1956	0	4,945	0	0	6,818	0	28	0	0	0	0	3,297	15,088
	1957	0	0	5,545	6,144	6,818	7,418	8,092	7,717	7,043	6,369	5,470	4,720	65,335
	1958	4,720	4,945	5,545	6,144	6,818	7,418	8,092	0	7,043	6,369	5,470	4,720	67,283
	1959	4,720	4,945	5,545	6,144	6,818	7,418	8,092	7,717	0	6,369	5,470	4,720	67,957
	1960	4,720	4,945	5,545	6,144	6,818	7,418	8,092	7,717	0	6,369	5,470	4,720	67,957
	1961	4,720	4,945	5,545	6,144	6,818	7,418	8,092	7,717	7,043	6,369	5,470	4,720	75,000
	1962	4,720	4,945	5,545	6,144	6,818	7,418	8,092	7,717	7,043	6,369	5,470	4,720	75,000
L	1963	4,720	4,945	5,545	6,144	6,818	7,418	0	0	0	0	3,388	4,720	43,697

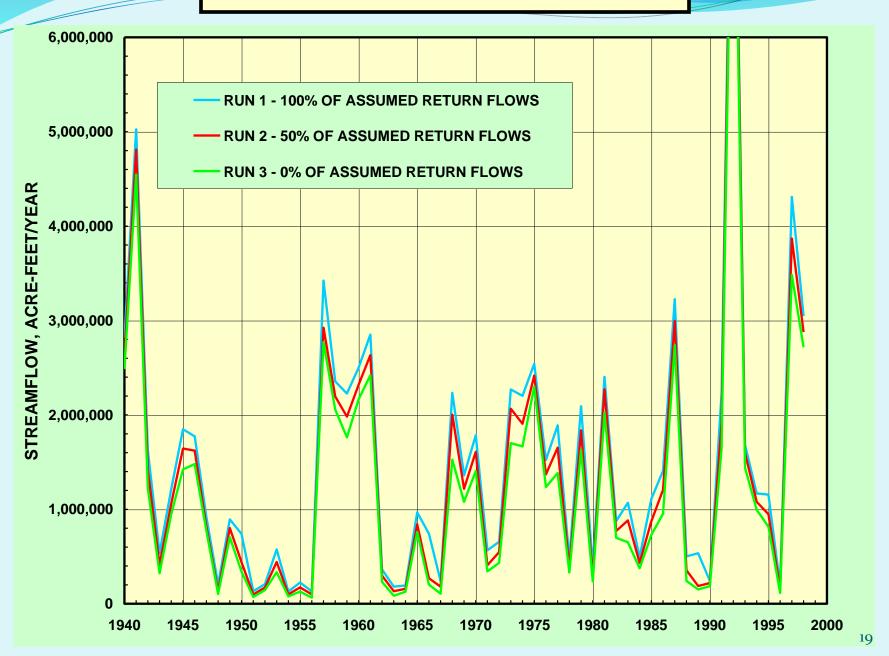
#### Simulated River Diversions



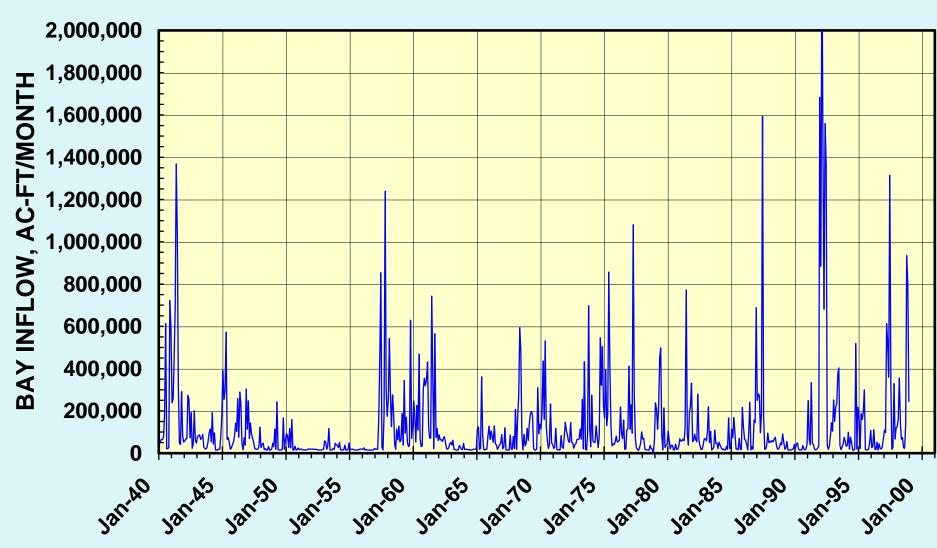
#### Simulated Reservoir Storage



#### Simulated River Flows



#### Simulated Matagorda Bay Inflows



# Important Features and Assumptions With Regard to Colorado Basin WAM

- 1) Monthly Time Step for Simulations Constant Monthly Flows, Demands/Diversions, Return Flows, Reservoir Storage
- 2) 1940 1998 Hydrology (Naturalized Flows)
- 3) Naturalized Flows Only at Primary Control Points
- 4) Simplified Channel Loss Representations
- 5) Constant Versus Climate-Variable Monthly Irrigation Demands
  - Authorized Annual Diversions
  - Annual/Monthly Climate Variations

- 6) LCRA Water Management Plan in Operation
  - Stipulates environmental flow requirements
    - Instream flows
    - Bay & estuary freshwater inflows
  - Stipulates LCRA interruptible water supply
  - Defines system storage triggers and quantities
- 7) Reservoir Storage Priority Honored
  - Full capacity associated with priority date
  - Senior reservoirs must be full before water available for junior water rights

- 8) Prior Appropriation Versus Natural Order Priority
  - Prior appropriation reflects legal requirements
  - Natural order reflects actual operations
  - Cutoff WAM reflects both priority systems
- 9) Full-Basin WAM Versus "Cutoff" WAM
  - o TCEQ WAM represents full basin
  - LCRA Cutoff WAM represents existing water rights agreements and current operations

- 10) Alternative Supplies Used to Meet Specific Demands
  - Use of Existing Water Rights
    - Different priority dates
    - Different locations
    - Unused water rights
  - o **Groundwater**
  - o Return flows
  - o Interbasin transfers
- 11) Specification of Return Flow Usage
  - Direct reuse
  - o Indirect reuse

- 12) Significant Special Agreements Among Water Right Holders
  - LCRA irrigation rights subordinated to Austin senior right (250,000 ac-ft/yr)
  - Austin municipal rights/demands backed up with LCRA Highland Lakes water
  - Town Lake maintained full with LCRA Highland Lakes water
  - Lake Buchanan water right subordinated to O. H. Ivie Reservoir
  - LCRA subordinations to San Angelo, CRMWD and Brown County WCID represented by "Cutoff" model
  - South Texas Plant demand backed up with LCRA Highland Lakes water

#### Stakeholders Use of WAMs

#### Senate Bill 3, Sec. 11.02362

In developing recommendations for environmental flow standards and strategies to meet the standards,

Stakeholders shall consider the BBEST's environmental flow analyses and environmental flow regime recommendations in conjunction with other factors, including present and future needs for water for other uses related to water supply planning.

#### WAM Provides an Analysis Tool for Examining Environmental Flow Recommendations and Balancing with Water Supply Needs

- Evaluate Extent to Which Existing and Future Flows May Satisfy Environmental Flow Recommendations
  - Run 3 Existing Water Rights Authorizations
  - Run 8 Current Conditions
- Evaluate Impacts of Environmental Flow Recommendations on Proposed Water Supply Projects
  - Run 9 Water Planning Strategies
  - Pending Water Rights Applications

### Science Advisory Committee Guidance Document No. 2010-04

# "CONSIDERATION OF METHODS FOR EVALUATING INTERRELATIONSHIPS BETWEEN RECOMMENDED SB-3 ENVIRONMENTAL FLOW REGIMES AND PROPOSED WATER SUPPLY PROJECTS"

October 2010

## Colorado-Lavaca Basin and Bay Area Stakeholder Committee

#### **QUESTIONS**

#### **Environmental Flow Locations**

